

B.2 ELECTROSTATIC PRECIPITATORS^{1,2,3,7,8,9,10,15,16}

B.2.1 Background

Electrostatic precipitators (ESPs) use electrical energy to remove PM from exhaust gas streams. As the exhaust stream enters an ESP, PM in the gas encounters negatively charged ions, which apply a charge to the particles. The charged particles then are attracted to collector plates carrying the opposite charge. As the particles accumulate, they periodically are removed from the collector plates and collected in a hopper. Electrostatic precipitators can be broadly classified as either dry ESPs or wet ESPs; the primary difference between these two classifications is the method by which the collector plates are cleaned. In dry ESPs, the plates are cleaned by applying a mechanical impulse or vibration to the plates, thereby knocking loose the collected PM. This cleaning method is referred to as rapping. In wet ESPs, collector plates are cleaned by rinsing with water. This section focuses on dry ESPs, which hereafter are referred to simply as ESPs. Wet ESPs are discussed further in section B.3 of this Appendix. Examples of ESP applications include: coal-fired boilers; cement kilns; solid waste incinerators; paper mill recovery boilers; catalytic crackers; metallurgical furnaces; sulfuric acid plants; and iron and steel sinter plants.

The primary components of an ESP are the shell or housing, discharge electrodes, collection electrodes, high voltage equipment, rapping system, and collection hoppers. The shell encloses and supports the electrical components of the unit. A discharge electrode is the component that creates ions that collide with the particles and applies the electrical charge to PM in the incoming gas stream. An ESP typically has a series of discharge electrodes. The two basic discharge electrode designs are the weighted-wire and rigid-frame electrode. Weighted-wire electrodes consist of wires suspended from a frame at the top of the unit with weights attached to the ends to keep the wires in place. In rigid-frame systems, both ends of the electrode wires are attached to a frame. The weighted-wire design typically has higher maintenance costs (due to wire breakage), but closer spacing is allowed between the collection and discharge electrodes. The collection electrodes, which typically are called plates, provide the collection surfaces for the particulates. Although collection plates come in a variety of shapes, most consist of closely spaced sheets of carbon steel. High voltage equipment includes a transformer, rectifier, and several meters. Collectively, this equipment is called a T-R set. The transformer steps up the input voltage from between 400 and 480 volts to between 20,000 and 70,000 volts. The rectifier converts the input current from alternating to direct current. Metering generally includes a primary voltmeter, which measures the input voltage; primary ammeter, which measures the current drawn across the transformer; secondary voltmeter, which measures the voltage applied to the discharge electrodes; secondary ammeter, which measures the current supplied to the discharge electrodes; and sparkmeter, which measures the spark rate across the electrodes. The rapping system, which removes collected PM from the collection plates, may be an external roof-mounted rapper or an internal rotating hammer rapper. Collection hoppers are bins located directly below the collection plates to temporarily store the collected PM until it can be disposed.

To maximize control efficiency, most ESPs are designed with several bus sections or fields, each of which is equipped with separate, independent power supplies, controllers, and meters. Each of these fields acts as a separate ESP. The power supplied to the initial fields generally is higher because PM concentrations are highest at the inlet. Having multiple fields allows the operator flexibility in operating the ESP and reduces the likelihood of electrical failure shutting down the entire ESP.

B.2.2 Indicators of ESP Performance

The primary indicators of ESP performance are PM concentration, opacity, secondary corona power, secondary voltage (i.e., the voltage across the electrodes), and secondary current (i.e., the current to the electrodes). Other indicators of performance are the spark rate, primary current, primary voltage, inlet gas temperature, gas flow rate, rapper operation, and number of fields in operation. Each of these indicators is described below. Table B-2 lists these indicators and illustrates potential monitoring options for ESPs.

Outlet PM concentration. Particulate matter CEMS can be used to continuously monitor PM emission concentrations. These instruments are a fairly recent development and have yet to be put into widespread use.

Opacity. As is the case for all dry PM controls, opacity is an indicator of control device performance.

Secondary corona power. The secondary corona power is a measure of the energy consumed in the removal of PM from the gas stream. A decrease in power generally indicates a decrease in control efficiency. Secondary corona power is the product of the secondary voltage and the secondary current, and typically is monitored by measuring the secondary voltage and secondary current separately. Because each field is independent of the others, secondary voltage and current should be monitored in each field of the ESP.

Secondary current. Secondary current is a measure of the current supplied to the discharge electrodes and is a partial indicator of the energy or power consumed by the ESP. The secondary current is usually measured in conjunction with secondary voltage to calculate the power. A drop in current may indicate a loss of power. Current at too high a level indicates a short-circuit or sparking. Measuring the secondary current helps in identifying which fields are operating properly.

Secondary voltage. Secondary voltage is a measure of the voltage applied to the discharge electrodes and is a partial indicator of the energy or power consumed by the ESP. Increases in voltage result in increased corona, greater particle charging, and increased control efficiency up to a critical voltage, above which excessive spark occurs and control efficiency decreases. A decrease in voltage indicates lower particle charging. A decrease in voltage with a corresponding increase in current indicates a short circuit or sparking. Measuring the secondary voltage helps in identifying which fields are operating properly.

Fields in operation. As explained previously, most ESPs are designed with multiple fields, each of which is operated independently of the others. If any of the fields fail, the overall performance of the ESP will decrease; that reduction in performance will be a function of which specific fields fail and which are still in operation.

The following operational parameters provide important information about the operation of the ESP but are not generally suited as indicators of performance for compliance monitoring per Part 64, although they may be useful supplements to a monitoring approach.

Spark rate. Under normal operation, electrical current repeatedly surges from the discharge electrodes to the collector plates in the form of sparks. Sparks result in an instantaneous termination of the electrical field (i.e., a short circuit in the field). As the secondary voltage increases, particle charging and sparking increase. As a result, there is an optimal range of spark rates within which there is a high degree of particle charging without excessive sparking. Spark rates outside this range generally indicate a decrease in control efficiency.

Primary current. Although secondary current is a better indicator of power consumption, the primary current is also an indicator of the power being consumed by the ESP. Low current levels indicate a potential problem with ESP operation.

Primary voltage. The primary voltage generally does not vary. However, this parameter can be used to identify a field that is not operating.

Inlet gas temperature. The control efficiency of an ESP depends partly on particle resistivity. Although particle resistivity is not typically monitored, resistivity decreases with increasing temperature. Therefore, changes in temperature can indicate changes in resistivity and the performance of the ESP. (Particles with low resistivity, i.e., less than 1×10^7 ohm-centimeters [Ω -cm] are difficult to collect because they lose their charge quickly and are not retained on the collection plates. Particles with high resistivity, i.e., greater than 1×10^{10} Ω -cm, are difficult to charge.) The inlet gas temperature may also be important to avoid condensation of components of the gas stream. The temperature must be maintained above the dew point.

Gas flow rate. The rate of gas flow through an ESP is an indicator of residence time. Control efficiency is a function of residence time; longer residence times allow for higher control efficiency (i.e., increased gas flow rate lowers the control efficiency and decreased gas flow increases the control efficiency).

Rapper operation. Rapper operation is an indication that collector plates are being cleaned at regular intervals and with the appropriate intensity. The process of rapping re-entrains a small amount of PM in the exhaust stream. Therefore, if rapping is too frequent or too intense, control efficiency is lower. On the other hand, if rapping is either too infrequent or of insufficient intensity to jar collected material loose, the dust layer on the collection plates becomes too thick and collection efficiency again decreases.

B.2.3 Illustrations

The following illustration presents an example of compliance assurance monitoring for ESPs:

- 2a: Monitoring secondary voltage, secondary current, and spark rate.
- 2b: Monitoring PM concentration (PM CEMS).

TABLE B-2. SUMMARY OF PERFORMANCE INDICATORS FOR ESPs

Parameter	Performance indication	1	2	3	4	5	6
		Approach No.					
		Illustration No.	2a				2b
		Example CAM Submittals			A25		
	Comment	✓		✓	✓	✓	✓
Primary Indicators of Performance							
Outlet PM concentration	PM concentration is the most direct indicator of ESP performance.						X
Opacity	Increased opacity or VE denotes performance degradation. COMS, opacity observations, or visible/no visible emissions.			X		X	
Secondary corona power	Performance usually increases as power input increases; indicates work done by ESP to remove PM. Product of voltage and current; can help identify any fields that are not operating.	a	a	a	a	X	
Secondary current	Partial indicator of power consumption; too low indicates malfunction. Can help identify any fields that are not operating properly.	X	X	X	X		
Secondary voltage	Partial indicator of power consumption; too low indicates problem such as grounded electrodes. Can help identify any fields that are not operating properly.	X	X	X	X		
Fields operating	Performance decreases when individual fields fail. Effect depends on which section goes out; need to test to determine effects of outages.					X	
Other Performance Indicators							
Inlet gas temperature	Temperature affects resistivity of particulate. Temperature is also an important parameter when the exhaust stream includes condensible pollutants.		X				
Gas flow rate	Indication of residence time in ESP. Performance is a function of residence time; an increase in flow rate decreases control efficiency, and a decrease in flow rate increases efficiency.						X

TABLE B-2. (Continued)

Parameter	Performance indication	Approach No.					
		1	2	3	4	5	6
		2a					2b
		Example CAM Submittals			A25		
		Comment	✓	✓	✓	✓	✓
Comments: • Approach No. 1 is required by some State and Federal rules; spark rate may also be required by some rules. • Approach No. 3 corresponds to 40 CFR 63, Subpart LL (Primary Aluminum Production). • 40 CFR 61, subpart K, uses Approach No. 4 along with primary current as an additional parameter. • Approach No. 5 is an EPRI-type approach where opacity and power are the major indicators of performance. This is a tiered approach where opacity is monitored on a regular basis with a COMS; but when opacity reaches a particular level, the facility begins to monitor secondary power (i.e., secondary voltage and secondary current) for input to a model. The model calculates PM emissions based on secondary voltage and secondary current, among other parameters. • Approach No. 6 corresponds to 40 CFR 63, subpart LLL (Portland Cement); PM CEMS monitoring is deferred. [LLL also allows opacity via M9.]							
^a Monitoring both secondary current and voltage is essentially the same as monitoring secondary corona power. Monitoring of corona power is not appropriate for ESPs with a large number of fields.							

CAM TECHNICAL GUIDANCE DOCUMENT
B.2 ELECTROSTATIC PRECIPITATORS

CAM ILLUSTRATION
No. 2a. ESP FOR PM CONTROL

1. APPLICABILITY

- 1.1 Control Technology: Electrostatic precipitator (ESP) [010, 011, 012]
- 1.2 Pollutants
 - Primary: Particulate matter (PM)
 - Other:
- 1.3 Process/Emissions units: Furnaces, combustors

2. MONITORING APPROACH DESCRIPTION

- 2.1 Parameters to be Monitored: Secondary voltage and secondary current.
- 2.2 Rationale for Monitoring Approach
 - Secondary current and voltage: Operating with these parameters outside of normal (design) specifications indicates a change in PM collection efficiency.
- 2.3 Monitoring Location
 - Secondary current and Secondary voltage: Measure after each transformer/rectifier set prior to electrode.
- 2.4 Analytical Devices Required:
 - Secondary current and Secondary voltage: Ammeters, voltmeters, other methods or instrumentation as appropriate; see section 4.6 for additional information on devices.
- 2.5 Data Acquisition and Measurement System Operation
 - Frequency of measurement: Hourly, or recorded continuously on strip chart or data acquisition system.
 - Reporting units:
 - Secondary current and Secondary voltage: Amps and volts
 - Recording process: Operators log data manually, or automatically recorded on strip chart or data acquisition system.
- 2.6 Data Requirements
 - Baseline secondary current and secondary voltage measurements concurrent with emissions test.
 - Historical plant records of secondary current and secondary voltage measurements.
- 2.7 Specific QA/QC Procedures: Calibrate, maintain, and operate instrumentation using procedures that take into account manufacturer's specifications.

3. COMMENTS

- 3.1 Data Collection Frequency: For large emission units, a measurement frequency of once per hour would not be adequate; collection of four or more data points each hour is required. (See Section 3.3.1.2.)

CAM ILLUSTRATION
No. 2b. ESP FOR PM CONTROL

1. APPLICABILITY

- 1.1 Control Technology: Electrostatic precipitator (ESP) [010, 011, 012]
- 1.2 Pollutants
 - Primary: Particulate matter (PM)
 - Other:
- 1.3 Process/Emissions units: Furnaces, combustors

2. MONITORING APPROACH DESCRIPTION

- 2.1 Indicators Monitored: Outlet PM concentration.
- 2.2 Rationale for Monitoring Approach: Direct measurement of PM concentration.
- 2.3 Monitoring Location: At outlet stack of ESP.
- 2.4 Analytical Devices Required: PM CEMS.
- 2.5 Data Acquisition and Measurement System Operation
 - Frequency of measurement: Continuous.
 - Reporting units: instrument response (e.g., milliamperes), or concentration (e.g., grains per dry standard cubic foot [gr/dscf], milligrams per dry standard cubic meter [mg/dscm]).
 - Recording process: Automatically recorded on data acquisition system.
- 2.6 Data Requirements
 - Baseline outlet PM concentration measurements concurrent with emissions test.
- 2.7 Specific QA/QC Procedures: An initial correlation test to develop the relationship between PM concentration and instrument response is required. QA/QC should, as a minimum, include: periodic calibration and drift checks, routine maintenance, and inventory of spare parts. Calibrate, maintain, and operate the CEMS using procedures that take into account the manufacturer's specifications.

3. COMMENTS

- 3.1 This illustration presents a general monitoring approach for using a PM continuous emissions analyzer as an indicator of performance; the indicator range must be selected and QA/QC procedures appropriate for the application must be implemented.
- 3.2 Note that § 64.3(d)(2) of the CAM rule indicates that CEMS that satisfy any of the following monitoring requirements are deemed to satisfy the general design and performance criteria for CAM and further justification for their use are not required:

- § 51.214 and Appendix P of 40 CFR 51;
- § 60.13 and Appendix B of 40 CFR 60;
- § 63.8 and applicable performance specifications of the applicable subpart of 40 CFR 63;

40 CFR 75;
subpart H and Appendix IX of 40 CFR 266; or
comparable requirements established by the permitting authority.

For PM CEMS, this includes Performance Specification 11 of 40 CFR 60, Appendix B.

- 3.3 Indicator ranges need not be specified for CEMS that provide data in units of the applicable emissions standard because the level of the standard is the level at which an excess emissions occurs. The use of CEMS that provide results in units of the standard for the pollutant of interest and meet the criteria presented in § 64.3(d)(2) is presumptively acceptable CAM. (See sections 2.2 and 3.4).

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B.3 WET ELECTROSTATIC PRECIPITATORS^{1,2,7,8,9,11,15,16}

B.3.1. Background

A wet electrostatic precipitator (WESP) typically is used to control PM emissions in exhaust gas streams containing sticky, condensible hydrocarbon pollutants, or where the potential for explosion is high. A WESP may be used to control a variety of emission points and pollutants, such as wood chip dryers; sulfuric acid mist; coke oven off-gas; blast furnaces; detarring operations; basic oxygen furnaces; cupolas; and aluminum potlines. In the wood products industry, WESPs often are used in combination with wet scrubbers or regenerative thermal oxidizers (RTOs) to control both PM and gaseous emissions. The general operating principles and components of ESPs and the specific features of dry ESPs are discussed in section B.2; this section focuses on the components and operation of WESPs that differ from those of dry ESPs.

The two primary differences between dry ESP and WESP design are the use of a prequench and the collector plate cleaning method. Unlike dry ESPs, WESP control systems typically incorporate a prequench (water spray) to cool and saturate the gases prior to entering the electrical fields. As PM accumulates on the collector plates of a WESP, the plates are cleaned by a continuous or intermittent film or spray of water. Major differences in the types of WESPs available include: the shape of the collector; orientation of the gas stream (vertical or horizontal); use of preconditioning water sprays; and whether the entire ESP is operated wet. Configurations include circular plate, concentric plate, tubular, and flat plate WESPs.

In circular-plate WESPs, the circular plates are irrigated continuously; this provides the electrical ground for attracting the particles and also removes them from the plates. Concentric-plate WESPs have an integral, tangential prescrubbing inlet chamber, followed by a vertical wetted-wall concentric ring ESP chamber. The discharge electrode system is made of expanded metal, with corona points on a mesh background.

Tube-type WESPs typically have vertical collecting pipes; electrodes are typically in the form of discs placed along the axis of each tube. The particles are charged by the high-intensity electric field, and, as they travel farther down the tube, they are forced to the tube walls by the electrostatic field. The tube walls remain wet because the fine mist entrained in the saturated gas is also collected on the tube surfaces and flows down along the tube walls. Flushing is performed periodically to clean the tube surfaces. The water is collected in a settling tank, and this water is used to quench the gaseous stream prior to its entering the WESP.

In rectangular plate WESPs (horizontal flow), water sprays precondition the incoming gas and provide some initial PM removal. Because the water sprays are located over the top of the electrostatic fields, collection plates are also continuously irrigated. The collected water and PM flow downward into a sloped trough. The last section of this type of WESP is sometimes operated dry to remove entrained water droplets from the gas stream.

The conditioning of the incoming gas stream and continual washing of the internal components with water eliminate re-entrainment problems common to dry ESPs. Efficiency is affected by particle size, gas flow rate, and gas temperature. Common problems with WESPs include: poor gas flow; high gas flow; poor water flow; low voltage; low current; and high dissolved solids in the flush or prequench water. Other common mechanical-type problems include: poor alignment of electrodes; bowed or distorted collecting plates; full or overflowing hoppers; plugged water sprays; corrosion of electrodes; and air inleakage.

B.3.2 Indicators of WESP Performance

The primary indicators of WESP performance are opacity, secondary corona power, secondary voltage, and secondary current. Other indicators of WESP performance are the spark rate, primary current, primary voltage, inlet gas temperature, gas flow rate, inlet water flow rate, solids content of flush water (when recycled water is used), and field operation. section B-2 describes each of these indicators with the exception of the inlet water flow rate and the flush water solids content, which are described below. For some systems, mist may be entrained in the exhaust gas. In such cases, opacity measurements would be misleading. Table B-3 lists these indicators and illustrates potential monitoring options for WESPs.

Inlet water flow rate. Because WESPs use water to clean collector plates, the water flow rate is an indicator that the cleaning mechanism is operating properly. If flow rates decrease, sections of the WESP may not be as effective. As a result, PM collection rates would decrease as material built up on the collectors. In addition, low flow rates increase the likelihood of ineffective spraying and distribution of water, as well as nozzle plugging.

Flush water solids content. When recycled water is used, the solids content of the water increases with each recycling. If the solids content becomes excessive, the effectiveness of the cleaning mechanism is reduced. Increased solids content also can lead to plugging of spray nozzles. This parameter is useful when used in conjunction with other more direct monitoring approach.

B.3.3. Illustrations

The following illustrations present examples of compliance assurance monitoring for WESPs:

- 3a: Monitoring secondary current, secondary voltage, spark rate, and inlet water flow rate.
- 3b: Monitoring secondary current, secondary voltage, inlet water flow rate, and flush water solids content.

TABLE B-3. SUMMARY OF PERFORMANCE INDICATORS FOR WESPs

Parameter	Performance indication	Approach No.	1	2	3	4	5
		Illustration No.	3a	3b			
		Example CAM Submittals				A9a	A9b
		Comment		✓	✓		
Primary Indicators of Performance							
Opacity	Increased opacity or VE denotes performance degradation. COMS, opacity observations, or visible/no visible emissions. If mist is entrained in exhaust gas or a condensed plume is present, opacity measurements may be misleading.				X		
Secondary corona power	Performance usually increases as power input increases; indicates work done by WESP to remove PM. Product of voltage and current; can help identify any fields that are not operating.	a	a				
Secondary current	Partial indicator of power consumption; too low indicates malfunction. Can help identify any fields that are not operating properly.	X	X				
Secondary voltage	Partial indicator of power consumption; too low indicates problem such as grounded electrodes. Can help identify any fields that are not operating properly.	X	X	X	X	X	X
Other Performance Indicators							
Inlet water flow rate	Indicates cleaning mechanism is working properly; if low, can indicate plugging. As an alternative to water flow, the water pressure can be monitored.	X	X	X	X		
Flush water solids content	High solids may cause plugging, reduce collection efficiency. Applies to systems that use recycled water.		X				
Inlet/outlet gas temperature	Indicates water sprays and prequench (if applicable) are working. Also, temperature affects resistivity of particulate.				X		X
Comments:							
• Approach No. 2 also corresponds to 40 CFR 60, subpart PPP (Wool Fiberglass).							
• Approach No. 3 includes monitoring the voltage to indicate that the WESP is collecting particulate, VE as an indicator of PM emissions, water flow to indicate PM being removed, and outlet temperature to indicate sufficient water.							

^a Monitoring both secondary current and voltage is essentially the same as monitoring secondary corona power. Monitoring of corona power is not appropriate for WESPs with a large number of fields.

^b No Part 63 rules refer to WESP.

CAM ILLUSTRATION
No. 3a. WET ELECTROSTATIC PRECIPITATOR FOR PM

1. APPLICABILITY

- 1.1 Control Technology: Wet electrostatic precipitator (WESP) [010, 011, 012]
- 1.2 Pollutants
 - Primary: Particulate matter (PM)
 - Other:
- 1.3 Process/Emission units: Wood products dryers

2. MONITORING APPROACH DESCRIPTION

- 2.1 Parameters to be Monitored: Secondary current, secondary voltage, and inlet water flow rate.
- 2.2 Rationale for Monitoring Approach
 - Secondary current: Current is generally constant and low; increase or drop in current indicates a malfunction. The current directly affects collection efficiency.
 - Secondary voltage: Voltage is maintained at high level; drop in voltage indicates a malfunction. When the voltage drops, less particulate is charged and collected. The voltage directly affects collection efficiency.
 - Inlet water flow rate: Indicates sufficient water flow for proper removal of particulate from the collection plates.

(Separate, independent indicator ranges typically would be established for each of the parameters; an excursion would occur if any one of the indicator ranges was exceeded.)
- 2.3 Monitoring Location
 - Secondary current and secondary voltage: Measure after each transformer/rectifier set.
 - Inlet water flow rate: Water line.
- 2.4 Analytical Devices
 - Secondary current: Ammeter.
 - Secondary voltage: Voltmeter.
 - Inlet water flow rate: Liquid flow meter or other device for liquid flow; see section 4 for more information on specific types of instruments.
- 2.5 Data Acquisition and Measurement System Operation
 - Frequency of measurement: Hourly, or continuously by strip chart or data acquisition system.
 - Reporting units:
 - Current: Amps.
 - Voltage: Volts.
 - Inlet water flow rate: Gallons per minute (gpm) or cubic feet per minute (ft³/min)
 - Recording process: Operators log data manually, or recorded automatically on strip chart or data acquisition system.

2.6 Data Requirements

- Baseline secondary current, secondary voltage, and inlet water flow rate measurements concurrent with emission test.
- Historical plant records on secondary current, secondary voltage, and inlet water flow rate measurements.

2.7 Specific QA/QC Procedures: Calibrate, maintain, and operate instrumentation using procedures that take into account manufacturer's specifications.

3. COMMENTS

- 3.1 Data Collection Frequency: For large emission units, a measurement frequency of once per hour would not be adequate; collection of four or more data points each hour is required. (See Section 3.3.1.2.)

CAM ILLUSTRATION
No. 3b. WET ELECTROSTATIC PRECIPITATOR FOR PM

1. APPLICABILITY

- 1.1 Control Technology: Wet electrostatic precipitator (WESP) [010, 011, 012]
- 1.2 Pollutants
 - Primary: Particulate matter (PM)
 - Other:
- 1.3 Process/Emission units: Insulation manufacturing, dryers

2. MONITORING APPROACH DESCRIPTION

- 2.1 Parameters to be Monitored: Secondary voltage and current, inlet water flow rate, and solids content of flush water.
- 2.2 Rationale for Monitoring Approach
 - Secondary current: Current is generally constant and low; increase or drop in current indicates a malfunction. The current directly affects collection efficiency.
 - Secondary voltage: Low voltage or current indicates a problem in the WESP.
 - Inlet water flow rate: Indicates sufficient water flow for proper removal of particulate from the collection plates.
 - Flush water solids content: High solids content of recycled water reduces the efficiency of cleaning.

(Separate, independent indicator ranges typically would be established for each of the parameters; an excursion would occur if any one of the indicator ranges was exceeded.)
- 2.3 Monitoring Location
 - Secondary current and secondary voltage: Measure after each transformer/rectifier set.
 - Inlet water flow rate: Measure at inlet water inlet line or pump discharge.
 - Flush water solids content: Measure at inlet line or recycle water tank.
- 2.4 Analytical Devices:
 - Secondary current: Ammeter.
 - Secondary voltage: Voltmeter.
 - Inlet water flow rate: Liquid flow meter or other device for liquid flow; see section 4 for more information on specific types of instruments.
 - Flush water solids content: Manual sampling of water.
- 2.5 Data Acquisition and Measurement System Operation
 - Frequency of measurement: Hourly, or continuously on strip chart or data acquisition system; flush water solids, weekly.
 - Reporting units:
 - Current: Amps.
 - Voltage: Volts.
 - Inlet water flow rate: Gallons per minute (gpm) or cubic feet per minute (ft³/min).
 - Flush water solids content: Percent solids.

- Recording process: Operators log data manually, or recorded automatically on strip chart or data acquisition system.
- 2.6 Data Requirements
- Baseline secondary current, secondary voltage, inlet water flow rate, and solids content measurements concurrent with emission test.
 - Historical plant records on secondary current, secondary voltage, inlet water flow rate, and solids content measurements.
- 2.7 Specific QA/QC Procedures: Calibrate, maintain, and operate instrumentation using procedures that take into account manufacturer's specifications.

3. COMMENTS

- 3.1 Data Collection Frequency: For large emission units, a measurement frequency of once per hour would not be adequate; collection of four or more data points each hour is required. (See Section 3.3.1.2.)